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III

THE GENUS POGOGYNE

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INTRODUCTION

Purpose.--The present study of the genus Pogogyne was begun when certain collections made by the writer on the plains of the San Joaquin Valley were not nicely determinable, although in treatments of the genus the species seemed rather definitely limited on comparative morphologic characters. And, the genus being small, it quickly appeared that here would be an admirable occasion for acquiring an experience in the study of species by a statistical method, coupled with, and governed by, the usual morphologic method. So a critical study of the genus Pogogyne was undertaken in order to determine more definitely the range of variation within the several species and to develop, if possible, by a statistical study of diagnostic criteria, quantitative data for the limitation of the species.

The statistical method employed in this work is of a primary sort, *i. e.,* the collection of quantitative data with a development of simple and evidently useful ratios and collations. Some, primarily interested in the fullest exploitation of a series of numerical compilations, will perhaps argue that this simple use of numerical facts cannot be properly called a statistical method, especially in view of the later complexities

developed in the field of biometry. But, as has been pointed out by Hall and Clements (Carnegie Inst. Publ. no. 326: 20, —1923), at this early stage of the use of statistical methods in flowering plant taxonomy the simplest uses of the figures furnish all the information now desirable, and a fuller development of them can follow later when such deductions will attain to more immediate usefulness and value. In the following presentment these simple data have been of primary importance in determining specific limits and drawing diagnoses, and in several instances tabulations are given to illustrate the value and the manner of compilation and comparison. Always, however, these facts have been used with a basic regard for the associated morphologic characters as determined by herbarium studies and field observations.

History.—The genus Pogogyne was first described by Bentham in 1834 in his monographic study of the Mint Family, Labiatarum Genera et Species. Three species were described, all having four perfect anthers, and the genus was placed in the tribe Melissineæ. In 1849, Bentham in Plantae Hartwegianae described the first species now characterized by sterile upper stamens, *P. zizyphoroides,* but he appears to have overlooked this stamen character for no account of it is given in his diagnosis and he states that the species is related to *P. parviflora,* a species with four fertile stamens. Torrey in the Botany of the Pacific Railroad Reports (1856) first described the total deficiency of the upper stamens in the type description of *P. serpylloides* which he placed, with question, in the genus Hedeoma. Gray in 1867 transferred Torrey's species to the genus Pogogyne, indicating a subgenus, Hedeomoides, characterized by only two fertile stamens, and in 1876 in the Botany of California, gave the first complete description of the genus as thus modified. Briquet in Die Natürlichen Pflanzenfamilien (1896) accepts two genera as representing the complex: first he reverts to Bentham's original concept of the genus Pogogyne, and then raises Gray's subgenus Hedeomoides to generic rank. Greene in the Manual of the Bay Region Botany (1894) and Jepson in the Flora of Western Middle California (1901) and in A Manual of the Flowering Plants of California (1925) follow the arrangement of Gray.

In the present work Gray's broader concept of the genus Pogogyne has been followed, two subgenera being recognized. Although Briquet's treatment is in keeping with the interpretation of generic limits that are based on staminal characters in certain sections of the Labiatæ, it seems obvious that his recognition of two genera here results in an artificial arrangement. The relatively wide separation of related units and the juxtaposition of relatively unrelated units in the sequence developed would seem to indicate this. On the other hand the two groups here accepted as subgenera show close relationship as shown by habit, leaves, inflorescence, and (aside from the stamen character) floral organs; and, moreover, the geographic distribution and physiological similarity of the species within the two groups also point to their very close relation.

Relationships.—Pogogyne belongs to the tribe Satureineæ of the Labiatæ as the family is treated by Bentham and Hooker and by Gray, and, by Briquet to the Stachyoideæ-Melissinæ, a smaller tribe identical with part of the Satureineæ. This latter is mainly characterized by 2-lipped, 10–15-nerved calyx, 2-lipped corolla, 2 or 4 stamens with the upper pair shorter and with anthers 2-celled. Within the tribe, Pogogyne is most nearly related to Hedeoma, and less closely, to Satureia.

In a family as intricate as the Labiatæ it is hazardous even to surmise the probable phylogeny of only a small part but in the case of Pogogyne morphologic and distributional evidence contribute facts that indicate a very possible line of development worthy of discussion. As stated above Pogogyne is related both to Hedeoma and to Satureia, probably through derivation from a common ancestral stock. Such a primitive group would be marked by such characters as perennial habit, simple inflorescence, unmodified calyx, and four fertile stamens, the upper pair smaller and tending to abort. Such a plexus might be considered similar to the large and complex genus Satureia as defined by Briquet (1896) which is marked by most of the characters just mentioned. It seems probable that due to some distributional or genetic arrangement a section of this original stock diverged and gave rise to the phylo-

genetic line that later developed the genera Hedeoma and Pogogyne, a line characterized by tendencies to annual habit, abbreviated inflorescence, and staminal reduction. The remainder of the complex can be considered as having maintained the old characters with only minor modifications, forming the modern genus Satureia and related genera.

In the Pogogyne-Hedeoma line, Hedeoma appears to be the older type with more numerous and more widely dispersed species, and with plants usually perennial, inflorescence noncongested, and calyx-lobes nearly undifferentiated. Although one subgenus of Pogogyne maintains the extra primitive character of four fertile stamens, a character not found in the rest of the Pogogyne-Hedeoma line, the annual habit, the involved inflorescence, and the bilabiate calyx in Pogogyne appear to be derived. These characters together with the relatively restricted distribution of the fewer species and the unusual physiological requirements for growth suggest a more highly specialized and lately evolved group in Pogogyne than in Hedeoma.

Within the genus Pogogyne there are two views to explain the possible origin and relationship of the two subgenera. Either they are two parts of a single line of development, a simple linear arrangement, or they represent two diverging lines from a common basal type. The latter view seems the more plausible in view of available morphologic and distributional evidence. In the subgenus Eupogyne, *P. douglasii* appears to be the least modified, *P. abramsi* marking a transition in habit and flower to *P. nudiuscula*. In the subgenus Hedeomoides the wide-spread species *P. serpylloides* appears less specialized than *P. zizyphoroides* both physiologically and morphologically, though the two are very nearly related. The little-known *P. tenuiflora* of Guadalupe Island probably represents a line of development originating near *P. serpylloides* but widely divergent from it, due perhaps to long-continued geographic isolation. A prototype of wide distribution similar to *P. tenuiflora* would probably be employed as an intermediate link between the subgenera by those who would have all the species of Pogogyne arranged in a linear sequence of development.

Distribution and Ecology. — Floristically, the genus Pogogyne is strictly Californian; at no place does a species extend beyond the limits of the California flora, and, at appropriate altitudes, the species pervade the area as completely as any group of Californian plants. The area here assigned to the California flora is somewhat enlarged over the province outlined by Jepson (Man. Fl. Pl. Calif. 1, 1925), and extends from middle western Oregon south to Mt. San Pedro Martir in northern Lower California and from the Cascade-Sierran crest west to the Pacific Ocean. In addition, the insular areas off the coast of California and Lower California are here considered a part of the California province as has been proposed recently by Mason in discussing the California Coast Range forest (Carnegie Inst. Publ. no. 346: 142, —1927). A remarkable feature of the distribution of the genus Pogogyne is how nearly coextensive it is with the province thus outlined. *Pogogyne zizyphoroides* extends north into southern Oregon, *P. serpylloides* occurs in northern Lower California, and *P. tenuiflora* is found on Guadalupe Island off Lower California where it is endemic. In life zones the species are best developed in the Lower and Upper Sonoran zones but *P. douglasii* and *P. serpylloides* also occur in the lower part of the Transition Zone.

The species of Pogogyne are generally characteristic of hollows in low valley lands inundated during the rainy season, the plants maturing after the ponds have dried and the summer heat has begun. *Pogogyne serpylloides* is partly an exception, for although it is sometimes found in the dried beds of former pools, it is more abundant on moist hillsides. In the sequence of floral societies characteristic of the rain pools of the Sacramento and San Joaquin valleys, Pogogyne occurs in the final or next to the final assemblage. As the water recedes from the bed of the pool, *Downingia bicornuta, D. ornatissima, Allocarya stipitata,* and *Mimulus tricolor* are most abundant on the moist or freshly dried bottoms. At this time Pogogyne develops vegetatively, sometimes beginning to bloom. In late spring and early summer when the beds of the pools are parched by the first drying heat, the more hydrophilous flora gives way to a society in which Pogogyne is conspicuous.

Navarretia leucocephala and *N. nigelliformis* reach maturity at this time, and *Lythrum hyssopifolia, Boisduvalia glabella,* and *Psilocarphus globiferus* are in flower or fruit. *Pogogyne douglasii minor* and *P. zizyphoroides* are the species frequently represented in this society. *Eryngium vaseyi,* a perennial which generally reaches maturity even later after most of these plants have passed, is sometimes a member of this late society. In Coast Range and Sierra Nevada valleys species of Pogogyne are also found in low areas, maturing generally during the summer; and in the vicinity of San Diego *P. nudiuscula* and *P. abramsi* blossom and fruit in the rain-pools on the elevated coastal plains at the end of the rainy season.

Acknowledgments.—The following study was undertaken and carried out at the California Academy of Sciences, and to Miss Alice Eastwood, Curator of Botany, the writer is indebted for the opportunity to do this work. The author also appreciates the opportunity afforded by the officers of other herbaria to borrow and study further material. These herbaria together with the symbol used in the citation of specimens are: Herbarium of the California Academy of Sciences (CA), Gray Herbarium of Harvard University (G), Herbarium of the University of Oregon (O), Herbarium of Pomona College (Po), Dudley Herbarium of Stanford University (St), Herbarium of the University of California (UC).

Taxonomic Treatment

Pogogyne Benth., Lab. Gen. et Spec. 414 (1834); Bentham *in* DeCandolle, Prodromus 12: 243 (1848); Bentham and Hooker, Genera Plantarum 2, pt. 2: 1190 (1876); Gray *in* Brewer and Watson, Bot. Calif. 1: 596 (1876); Gray, Syn. Fl. N. Am. 2, pt. 1: 364 (1878); Greene, Man. Bay Reg. Bot., 289 (1894); Howell, Fl. NW. Amer., 551 (1901); Jepson, Fl. West. Mid. Calif., 461 (1901); Jepson, Man. Fl. Pl. Calif., 873 (1925).

Annual herbs of spring and summer with numerous punctate glands, the glandular secretion with an aromatic or rank

odor; stems 0.25–4.5 dm. long, assurgent to strictly erect, simple or branched, glabrous or frequently with a fine retrorse pubescence; leaves suborbicular to oblanceolate-spathulate and linear, simple, entire or obscurely to saliently serrate, obtuse or acute, attenuate below into a short petiole, the margin of the upper leaves becoming bristly-ciliate; floral bracts 2 below each flower, shorter to longer than the calyx, spathulate to oblanceolate and linear, generally entire, the margin conspicuously and sometimes densely bristly-ciliate; flowers numerous, congested in axillary cymules and appearing verticillate, or rarely the flowers solitary or few in the lowest axils, the lower clusters frequently discrete, the upper crowded and the inflorescence becoming spicate-capitate; calyx 15-nerved, the tube slender-campanulate, 1–5 mm. long, punctate-glandular, glabrous or pubescent or rarely hirsute; calyx-lobes linear-deltoid, acute, disposed in two sets, glabrous or hairy or hirsute, the margins generally ciliate, the lower lip 2-lobed, 2–8 mm. long, the upper lip 3-lobed, 1.5–5 mm. long; corolla 2.5–20 mm. long, tubular-funnelform, lavender to purple, the palate frequently mottled with pale yellow, pubescent and sometimes glandular without, pubescent or glabrous within, 2-lipped, the upper lip nearly plane, entire, the lower lip 3-lobed; stamens erect under the upper lip of corolla, 4 or 2 with fertile, 2-celled anthers, the anthers and filaments more or less hairy, the lower pair of stamens always fertile, the upper pair shorter, fertile or sterile or obsolete, the sterile stamens when present simple or capitellate; style about equalling the corolla, more or less hairy below the branches; style-branches unequal to subequal, glabrous; nutlets 1–2.5 mm. long, narrow- to rotund-obovate, hairy and sometimes glandular on the rounded apex, light to dark brown, concolorous or mottled.

Key to Subgenera and Species

a. Corolla 9–20 mm. long; four stamens fertile, lower pair 3.5–6 mm. long; style rather densely hairy 2–6 mm. below style-branches; style-branches unequal to nearly equal.....Subgenus Eupogogyne

b. Floral bracts and calyx-lobes conspicuously hirsute, bristly-ciliate.

c. Inflorescence 1–3 cm. broad; calyx-tube 3–4 mm. long, (2–3 mm. long in subspp.); lower calyx-lobes 2–4 mm. longer than upper (except in subsp. *parviflora*); style 13–20 mm. long; north of the Tehachapi region.....1. *P. douglasii*

cc. Inflorescence 0.4–0.8 cm. broad; calyx-tube 2 mm. long; lower calyx-lobes 1 mm. longer than upper; style 12 mm. long; San Diego.....2. *P. abramsi*

bb. Floral bracts and calyx-lobes glabrous or subglabrous; inflorescence 1–1.5 cm. wide; calyx-tube 3–4 mm. long; San Diego.....3. *P. nudiuscula*

aa. Corolla 2.5–12 mm. long; upper pair of stamens sterile, sometimes deficient; lower pair fertile, 0.5–2 mm. long; style sparsely hairy to 1 mm. or less below style-branches (except in no. 6); style-branches generally unequal.....Subgenus Hedeomoides

d. Corolla tubular, 2.5–8 mm. long; style hairy 1 mm. or less below style-branches.

e. Stems prostrate or spreading, slender (except in subsp.); calyx-tube 1–2.5 (or 3.5) mm. long; corolla 2.5–5 mm. long; rudiments of upper stamens present or lacking; nutlets 1 mm. long.....4. *P. serpylloides*

ee. Stems erect or suberect, generally robust, calyx-tube 2.5–5 mm. long; corolla 4–8 mm. long; rudiments of upper stamens present; nutlets 1.7–2.5 mm. long.....5. *P. zizyphoroides*

dd. Corolla tubular-salverform, 12 mm. long; style hairy 3 mm. below style-branches.....6. *P. tenuiflora*

Subgenus **Eupogogyne** J. T. Howell, subgen. nov.

Pogogyne Benth., Lab. Gen. et Spec. 414 (1834).
Pogogyne Briquet *in* Engler and Prantl, Nat. Pfl. 4, abt. 3a: 304 (1896).

1. **Pogogyne douglasii** Benth., Lab. Gen. et Sp. 414 (1834)

Stems erect or suberect, 0.5–4.5 dm. tall, glabrous to puberulent, simple or becoming branched near the base, the branches

spreading and assurgent; leaf-blade 1–2 cm. long, 0.2–1.5 cm. wide, slender-oblanceolate to oblong and elliptic, mostly obtuse, margin entire or coarsely serrate, glabrous, attenuate below to a broad petiole; floral bracts linear to oblanceolate, pungently acute to obtuse, equalling or exceeding the calyx, margin conspicuously bristly-ciliate; inflorescence densely flowered, congested-capitate and short to long-oblong, or the whorls in the lower axils discrete; lower calyx-lobes 3–8 mm. long, the upper lobes 2–5 mm. long, the margins ciliate; calyx-tube 2–4 mm. long, glabrous or the nerves pubescent; corolla 0.9–2 cm. long, lavender to purple, the palate of the lower lip frequently mottled with pale yellow, the outside of the corolla more or less pubescent; stamens fertile, the anthers and upper part of filaments hairy, the lower pair of stamens 3.5–6 mm. long, the upper pair 1–3 mm. long; style 0.8–2 cm. long, somewhat exceeding the corolla, hairy 2–6 mm. below the branches; style-branches equal or unequal; nutlets 1–1.7 mm. long, obovate, dark to light brown.

Low areas in the foothills and valleys: Butte County south to Kern and San Luis Obispo counties, California.

The original publication of the genus Pogogyne was accompanied by the descriptions of three species based on specimens collected by Douglas in California, *P. douglasii, P. multiflora,* and *P. parviflora.* The three were differentiated on relative lengths of floral bracts and flowers, of calyx-tubes and calyx-teeth, and of stamens and corollas. After a careful study of numerous collections it is believed that these three species of Bentham are parts of a single variable specific unit and they are here accepted as constituting the species *P. douglasii. Pogogyne parviflora* which is rather clearly marked by the relative length of calyx-tube and lower calyx-teeth and which occupies a distinct geographic area is here treated as a subspecies. The characters which Bentham used to separate *P. douglasii* and *P. multiflora* (the relative lengths of floral bracts and flowers, and of corollas and stamens) have been found to intergrade and vary to such a degree that the latter species is here considered a synonym of *P. douglasii.*

KEY TO SUBSPECIES OF *P. douglasii*

a. Lower calyx-teeth 1.5–2.5 times as long as the calyx-tube.

b. Calyx-tube 3–4 mm. long; corolla 15–20 mm. long; style hairy 4–6 mm. below the branches; plants robust, frequently branched ..... *1a. typica*

bb. Calyx-tube 2–3 mm. long; corolla 9–14 mm. long; style hairy 2–3 mm. below the branches; plants of low stature.

c. Plants branched, pale with close white pubescence and numerous white bristles ..... *1b. ramosa*

cc. Plants simple, green or the floral bracts frequently purplish-tinged ..... *1c. minor*

aa. Lower calyx-teeth 1–1.5 times as long as the calyx-tube ..... *1d. parviflora*

1a. **Pogogyne douglasii typica** J. T. Howell, nom. nov.

Pogogyne douglasii Benth., Lab. Gen. et Sp. 414 (1834).
P. multiflora Benth., *loc. cit.*
P. douglasii var. *multiflora* (Benth.) Briquet *in* Engler and Prantl, Nat. Pfl. 4, abt. 3a: 304 (1896).

Stems generally robust, 2–4.5 dm. tall, simple or branched; bracts of the inflorescence oblanceolate or linear, green; inflorescence dense and spicate or the lower floral whorls distinct, mostly 2–3 cm. broad; length of lower calyx-lobes 1.5–2.5 times the length of the calyx-tube; calyx-tube 3–4 mm. long, glabrous or somewhat pubescent; corolla 15–20 mm. long; style hairy 4–5 mm. below the style-branches.

Foothills and valleys of the Coast Ranges and Sierra Nevada from Lake and Butte counties south to Kern and San Luis Obispo counties.

The type localities of both *P. douglasii* Benth. and *P. multiflora* Benth. are given in the original publication as "in California septentrionali."

Collections. California: Kelseyville, Lake Co., *Blankinship in 1927* (CA); Leesville, Colusa Co., *Heller 12387* (CA, G, St); Calistoga, Napa Co., *Eastwood 4626* (CA, G); Pope Valley, Napa Co., *J. T. Howell 4278 and 4370* (CA); Ala-

meda, Alameda Co., *Kellogg & Harford 730* (CA); Walnut Creek, Contra Costa Co., *Elmer 4320* (CA, Po, St, UC); Pajaro Hills, Monterey Co., *Chandler 441* (UC); San Simeon Bay, San Luis Obispo Co., *Palmer 351* (UC); Santa Margarita Valley, San Luis Obispo Co., *Summers in 1882* (UC); near Chico, Butte Co., *Palmer 2078* (Po); Nelson, Butte Co., *Heller 11390* (CA, G, St, UC); Wawona, Mariposa Co. *Eastwood in 1923* (CA); near Bootjack, Mariposa Co., *J. T. Howell 6678* (CA); Raymond, Madera Co., *Eastwood 12521* (CA); Fresno Flats, Madera Co., *Hall 1552* (UC); Big Sandy Creek, Fresno Co., *McDonald in 1915* (CA); California, *Douglas* (G); California, *Hartweg 1914* (G).

The Douglas collection cited above is undoubtedly a part of the type collection of *P. multiflora* Benth. since the floral bracts are mostly shorter than the flowers and the stamens are exserted. The collection, *Hartweg 1914,* is listed in Plantae Hartwegianae as *P. multiflora* by Bentham, but in the specimen in the Gray Herbarium the stamens are not conspicuously exserted.

The following specimens from the plains of southern and eastern Solano Co. exhibit intermediate characters between subsp. *typica* and subsp. *minor:* Vanden Station, *Heller 5594* (G, St); Elmira, *Baker 2899* (G, Po, UC); Benicia, *Abrams 5746* (St). In habit and foliage these plants resemble low forms of subsp. *typica* and in amount of hairiness on the style the specimens are like subsp. *typica.* In length of calyx and corolla the plants are generally nearer subsp. *minor* though occasionally exceptions occur. Here they are placed as non-typical forms of subsp. *typica.*

As plants of *P. douglasii* pass from youth to maturity and old age, they become branched from the base, the cauline and larger floral leaves drop off, and the corolla is notably reduced. This change is well shown by comparing two collections made from the same pool-bottom near Pope Valley, Napa Co., in May *(J. T. Howell 4278)* and in July *(J. T. Howell 4370).* If field evidence were not available to show the later development of the plants, such extreme types as *Bolander 2667* from Lake Co. (UC) and *Brewer 855* from Napa Valley (UC) might be treated as new forms.

An attempt was made to segregate the forms of subsp. *typica* in the Sierran foothills from those in the Coast Ranges. The more slender inflorescence, the narrower floral bracts, and the more abundant hairs of the floral bracts and calyx-lobes are noticeable characters of the Sierran plants but these characters varied just enough in plants on both sides of the Great Valley that, in too many instances, the erection of a critical line of division between the forms would have been arbitrary.

1b. **Pogogyne douglasii ramosa** J. T. Howell, subsp. nov.

Stem slender, assurgent, 1–1.5 dm. tall, white-hairy especially above, branched at or above the base; bracts of the inflorescence oblanceolate to linear, green, densely white-ciliate on the margins and puberulent on the surfaces; inflorescence more or less interrupted-spicate, 1–1.5 cm. broad, ovate to lanceolate; length of lower calyx-lobes 2 times the length of the calyx-tube; calyx-tube 2–3 mm. long, nerves white-bristly; corolla 11–13 mm. long, conspicuously hairy outside; style hairy 3 mm. below the style-branches.

Dried beds of winter pools in the San Joaquin Valley.

Type: no. 171693, Herb. Calif. Acad. Sci., collected by J. T. Howell (no. 2004), **near Merced, Merced Co., Calif.** Only one other collection has been seen, that of Rattan at Live Oaks, San Joaquin Co., Calif., in 1880 (St).

1c. **Pogogyne douglasii minor** J. T. Howell, subsp. nov.

Stems 0.5–1 (or rarely 2) dm. tall, very slender, simple; bracts of the inflorescence narrowly linear to acicular, acerose-pointed, green or frequently purplish, the margins densely white-ciliate; inflorescence short-capitate, 1–2 cm. broad; length of the lower calyx-lobes 1.6–2.5 times the length of the calyx-tube; calyx-tube 2–2.5 mm. long, white-hairy; corolla 9–14 mm. long; style hairy 2–3 mm. below style-branches.

Depressions on low clay hills bordering the Sacramento and San Joaquin valleys from Tehama Co. south to Madera Co.

Type: no. 171692, Herb. Calif. Acad. Sci., collected by J. T. Howell (no. 4211), **near Merced, Merced Co., Calif.**

Other collections. California: eight miles south of Vina near Pine Creek, Tehama Co., *Heller 11334* (CA, G, St, UC); Glenn Co., *L. E. Smith in 1916* (CA); Folsom, Sacramento Co., *Hannibal in 1918* (St); Raymond, Madera Co., *Cummings in 1896* (G).

The collection from Poso Creek Valley in the foothills of the southern Sierra Nevada, *Dudley 543* (St), intergrades with subsp. *typica*. In technical characters of length of calyx-tube and hairiness of style it agrees with subsp. *minor* but in other characters it resembles more diminutive aspects of subsp. *typica*.

1d. **Pogogyne douglasii parviflora** (Benth.) J. T. Howell, comb. nov.

Pogogyne parviflora Benth., Lab. Gen. et Spec. 414 (1834).

Stems rather slender, 2–3 dm. tall, simple or generally branched; bracts of the inflorescence oblanceolate to linear, mostly green; inflorescence dense and capitate, 1–2 (or 2.5) cm. broad; length of lower calyx-lobes 0.75–1.5 times the length of the calyx-tube; calyx-tube 2.5–4 mm. long, glabrous or somewhat hairy; corolla 11–15 mm. (or 17) mm. long; style hairy 4 mm. below the style-branches.

Low places in Coast Range valleys of Sonoma, Mendocino, and Lake counties.

Pogogyne parviflora Benth. was first collected by Douglas "in California septentrionali."

Collections. California: Sherwood Valley, Mendocino Co., *Dudley in 1899* (St); between Willits and Laytonville, Mendocino Co., *Abrams 5817* (St); Kelseyville, Lake Co., *Blankinship* (CA); Batchelor Valley, Lake Co., *Rattan in 1883* (St); between Cotati and Santa Rosa, Sonoma Co., *Eastwood 10620* (CA); Santa Rosa, Sonoma Co., *Heller 5642* (G, Po, St); Mark West, Sonoma Co., *Bolander 3901* (UC).

The plant represented by plate no. 5886 of Curtis' Botanical Magazine is probably *P. douglasii parviflora* and not *P.*

TABLE 1—SHOWING VARIATION IN CERTAIN SPECIES OF POGOGYNE

LOCALITY (all in California)	Herbarium	Lower calyx-lobes, length	Upper calyx-lobes, length	Calyx-tube, length	Ratio of lower calyx-lobe to calyx-tube	Corolla, length	Bearded part of style, length
Pogogyne douglasii typica.		*mm.*	*mm.*	*mm.*		*mm.*	*mm.*
Leesville	CA 25661	7	4	4	1.75	16	5
Calistoga	CA 25660	6	3	4	1.50	18	4
Walnut Creek	CA 25662	6	4	3	2.00	16	5
Alameda	CA 25652	6	4	4	1.50	18	5
Pajaro Hills	UC 25587	6	4	4	1.50	15	4
San Luis Obispo	UC 104540	8	4	4	2.00	15	5
Nelson	CA 25657	5	3	3	1.66	16	5
Wawona	CA 25655	6	4	3	2.00	16	5
Raymond	CA 128084	5	2	3	1.66	18	4
Big Sandy Creek	CA 25659	5	2	3	1.66	18	5
Average		6.0	3.4	3.5	1.72	16.6	4.7
Pogogyne douglasii minor.							
Vina	CA 25656	5	2	2	2.50	14	3
Glenn County	CA 25654	4	2	2	2.00	13	3
Merced	CA 171692	5	2	2.5	2.00	14	3
Poso Creek	St 23744	5	3	2	2.50	15	3
Average		4.7	2.2	2.1	2.25	14	3
Pogogyne douglasii parviflora.							
Ukiah	UC 25591	4	3	4	1.00	15	4.5
Kelseyville	CA 165111	3	2	3	1.00	13	4
Mark West	UC 25594	4	3	3	1.33	11	4
Cotati	CA 25653	4	2	4	1.00	17	4
Average		3.7	2.5	3.5	1.08	14	4.1

douglasii as named, for the length of the lower calyx-lobes equals the length of the calyx-tube.

2. **Pogogyne abramsi** J. T. Howell, spec. nov.

Stems 0.5–2 dm. tall, simple and erect or branched and suberect to diffuse; leaf-blade 0.5–1.5 cm. long, 0.1–0.5 cm. wide, oblong to linear-oblanceolate, entire or frequently saliently toothed, pubescent or glabrous, narrowed below to a short petiole, the petioles and margins of the upper leaves conspicuously bristly-ciliate; floral bracts white-ciliate, narrowly linear, pungently acute, equalling the calyx or shorter; flowers in slender terminal spike or the lower whorls somewhat distinct; calyx-tube 2–2.5 mm. long, densely white-hairy on the veins outside; lower calyx-lobes 3–4 (or 6) mm. long, the upper lobes 2–3 (or 5) mm. long, all about 0.5 mm. broad at base, the margins hairy and bristly-ciliate, the veins hairy; corolla 10–12 mm. long; lower stamens 4–4.5 mm. long, sparsely hairy, upper stamens 1–2 mm. long, fertile, glabrous; style 12 mm. long, hairy 2–4 mm. below the branches; style-branches unequal to nearly equal; nutlets 1–1.5 mm. long.

Depressions on the mesas and "sandy flats inundated during rains," western San Diego Co.

Type: no. 162150, Herb. Calif. Acad. Sci., collected by Abrams (no. 3446), on **mesa north of San Diego, San Diego Co., Calif.**

Other collections. California: mesa north of San Diego, *Abrams 3446* (G, Po, St); mesas north of San Diego, *Chandler 5346* (St, UC); near San Diego, *Hall 3924* (St, UC); vicinity of San Diego, *Spencer 127* (G, UC); Linda Vista. *T. S. Brandegee in 1894* (UC); clay soil of dried rain-pools, 11 miles northeast of San Diego, *J. T. Howell 6636* (CA, G, O, Po, St, UC).

Distinguished in appearance and marked by several excellent characters, the plant here described seems amply distinct from *P. nudiuscula* to be given specific recognition. All specimens save one that have been examined are labelled *"P. nudiuscula"* yet no diagnosis of that species describes the unusual charac-

ters of the present plant. Undoubtedly it would have received early recognition if its distribution were not so nearly coextensive with that of *P. nudiuscula.* But there are no "intermediates," the two species being more easily separable than certain forms of the long-recognized species, *P. serpylloides* and *P. zizyphoroides.* In habit *P. abramsi* is more slender and the character of vesture marks it at once. The leaves are frequently lobed and the floral bracts are very narrow and pungent. The calyx of *P. abramsi* is smaller in all parts than is the calyx of *P. nudiuscula,* while the corolla and style are generally longer in the latter. The stamens are fertile in both species but in the present species both pairs are shorter than the corresponding pairs in *P. nudiuscula.*

Little is known of the field relationships of *P. nudiuscula* and *P. abramsi* but it is evident from collections in the herbaria that the two species do not grow together, for they have never been mixed in a single collection and no collector has noted the variation which would be so conspicuous if the plants were associated. Further field work might reveal a physiological barrier which separates the two besides determining more accurately the distribution of each.

The following field notes accompany the last of the specimens cited above: tube of the corolla slender, widening into the campanulate throat; the upper lip of the limb cucullate, the lobes of the lower lip reflexed; limb and throat rich rosy-purple, tube white; middle lobe of lower lip with central yellow area spotted with deep purple; lateral lobes of lower lip with a median line of similar purple but with no yellow; the two lower stamens and the style exserted and curved from under the upper lip.

3. **Pogogyne nudiuscula** Gray, Bot. Cal. 1: 597 (1876).

Stems 1–3 dm. tall, simple to much-branched, suberect or somewhat spreading; leaf-blades 0.5–1.5 cm. long, 0.2–0.5 cm. wide, ovate to oblong, obtuse or acute, subentire, glabrous, narrowed below to petiole 0.2–0.5 cm. long; floral bracts oblanceolate to oblong-linear, glabrous or with few marginal

hairs, equalling the calyx or shorter, or the outermost sometimes exceeding the calyx; flowers in distant axillary whorls or the upper whorls capitate-congested; calyx-tube 3–4 mm. long, conspicuously veined, glabrous or very sparsely hairy; lower calyx-lobes 3–5 mm. long, the upper lobes 2–4 mm. long, all lobes 1 mm. broad at base, the margins of the lobes glabrous, rarely thinly ciliate; corolla 11–14 mm. long, sparsely hairy outside, lavender; lower pair of stamens 5–6 mm. long, upper part of filaments hairy, upper stamens 2–3 mm. long, fertile, glabrous; style equalling or slightly exceeding the corolla, 11–15 mm. long, hairy to 1.5–4 mm. below style-branches; style-branches nearly equal; nutlets 1.5 mm. long.

On the mesas of western San Diego Co. near San Diego, the region of the type locality.

Collections. California: San Diego, *Cleveland in 1874* (type, G); San Diego, *Greene in 1902 (Baker distribution no. 1655)* (CA, G, Po, UC); San Diego, *Dunn in 1891* (CA, UC); mesas near San Diego, *Chandler 5345* (UC, St); Mission Valley, San Diego, *T. S. Brandegee in 1894* (UC); East San Diego, *Spencer 548* (G, Po); University Heights on "hog wallows," *Alderson 998* (St).

Subgenus **Hediomoides** Gray, Proc. Amer. Acad. 7: 386 (1867).

Hediomoides (Gray) Briquet *in* Engler and Prantl, Nat. Pfl. 4, abt. 3a: 295 (1896).

4. **Pogogyne serpylloides** (Torr.) Gray, Proc. Amer. Acad. 7: 386 (1867).

Stems numerous from the base and diffusely spreading, or rarely simple and suberect, 0.25–2.5 dm. long; leaf-blade oblongish to ovate and broadly elliptic, obtuse, entire or minutely crenulate or obscurely serrulate, 0.2–1.2 cm. long, 0.1–0.8 cm. wide, narrowed below to a petiole 0.1–0.7 cm. long; floral bracts spathulate to linear-oblanceolate, equalling or exceeding the calyx, margins somewhat ciliate-pubescent; flowers in dis-

crete axillary whorls or the upper whorls congested and the inflorescence becoming capitate; calyx-tube 1–3.5 mm. long, nerves thinly pubescent; lower calyx-lobes 2–4 mm. long, the tips spreading in fruit, the upper lobes 1.5–3 mm. long, the margins of the lobes ciliate; corolla lavender or lilac, hairy or glabrous without, 2.5–5.5 mm. long; lower pair of stamens fertile, 0.5–1.5 mm. long, the upper pair sterile with or without rudiments of anthers, or both upper stamens entirely lacking; style included in or equalling the throat of corolla, 2–4 mm. long, lightly hairy below branches; nutlets rotund-ovate, dark brown, mottled or not, 1–1.3 mm. long.

Hillsides and low valley lands: Sierra Nevada foothills from Eldorado Co. to Mariposa Co.; Coast Ranges from Humboldt Co. to San Luis Obispo Co., east to Lake and San Benito cos.; northern Lower California.

Key to Subspecies of *P. serpylloides*

a. Stems slender and spreading; whorls of the inflorescence discrete.....*4a. typica*

aa. Stems more stiffly erect, few-branched; whorls of inflorescence approximate, forming oblong, capitate spike.....*4b. intermedia*

4a. **Pogogyne serpylloides typica** J. T. Howell, nom. nov.

Hedeoma (?) serpylloides Torr., Pac. R. R. Rep. 4: 123 (1856).
Pogogyne serpylloides (Torr.) Gray, Proc. Amer. Acad. 7: 386 (1867).
Hediomoides serpylloides (Torr.) Briquet *in* Engler and Prantl, Nat. Pfl. 4, abt. 3a: 295 (1896).

Plants generally much-branched from the base, the stems flexuous and spreading, or rarely in undeveloped diminutive plants, the stem simple but slender; flowers in distinct axillary whorls, the whorls rarely congested and capitate in small plants.

Sierra Nevada and Coast Range hills from northern California to northern Lower California.

"Hillsides, Martinez" is the type locality of *Hedeoma serpylloides* Torr.

Collections. California: New York Ravine, Eldorado Co., *K. Brandegee in 1907* (UC); near Copperopolis, Calaveras Co., *Davy 1391* (Po, UC); Mokelumne Hill, Calaveras Co., *Blaisdell* (CA); New York Falls, Amador Co., *Hansen 447* (St, UC): French Flat, Tuolumne Co., *Williamson 53* (CA, Po, St); Cathay Valley, Mariposa Co., *Eastwood 4332* (CA, G); Butler Valley on Mad River, Humboldt Co., *Tracy 2621 and 2622* (UC); Rowes, Mendocino Co., *Chandler 1060* (UC); Ukiah, Mendocino Co., *Kellogg and Harford 728* (CA, G); Kelseyville, Lake Co., *Blankinship in 1923* (CA); Pope Creek Canyon, Napa Range, Napa Co., *J. T. Howell 6113* (CA); Healdsburg, Sonoma Co., *Rattan in 1877* (St); Martinez, Contra Costa Co., *Bigelow in 1854* (type collection, G); Bald Peak, Contra Costa Co., *J. T. Howell 4747* (CA, G, O, Po, St, UC); Berkeley Hills, Alameda Co., *Eastwood in 1907* (CA); Oakland, Alameda Co., *Jones 2833* (CA, Po, St); Fort Point, San Francisco, *Kellogg and Harford 729* (CA, G); Arroyo Mocho, Alameda Co., *J. T. Howell 1802* (CA); near Stanford University, Santa Clara Co., *Baker 543* (G, Po, St, UC); between Gilroy Spring and Madrone Spring, Santa Clara Co., *Dudley 4154* (CA, St); Tres Pinos River 5 miles above Pacaines, San Benito Co., *Abrams and Borthwick 7807* (Po, St); Monterey Co., *Abbott* (CA); Cambria, San Luis Obispo Co., *Eastwood 13596* (CA). Lower California: near San Quintin, northern Lower California, *Orcutt 1361* (G, UC).

Unlike the other species of the genus, this form is not so nearly confined to low places where pools form during winter rains, but rather appears to be more abundant on slopes of hills near protecting thickets and brush. Only two collections that have been examined carry the record that the specimens were collected on the beds of former pools. Although there is considerable variation noted in the size and aspect of plants in this variety, such variation is believed to be due entirely to edaphic and climatic influences.

TABLE 2—SHOWING VARIATION IN CERTAIN SPECIES OF POGOGYNE

LOCALITY	Herbarium	Lower calyx-lobes, length	Upper calyx-lobes, length	Calyx-tube, length	Corolla, length	Lower stamens, length	Nutlets, length
Pogogyne serpylloides.		*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*
Kelseyville, Calif.	CA 165110	2.5	2	2.5	5	1.5	1.2
Oakland, Calif.	CA 25679	2.5	1.5	2.5	5.5	1	1.2
Monterey Co., Calif.	CA 25677	3.5	2.5	1.5	3.5	1	1.1
Cambria, Calif.	CA 140011	3	2	1	3	1	1
Mokelumne Hill, Calif.	CA 25680	4	3	2	4	1	1.3
French Flat, Calif.	CA 25678	3	2.5	1.5	4.5	1	1.1
Cathay Valley, Calif.	CA 25673	3	2	2	5	1	0.9
San Quintin, Lower Calif.	UC 25599	4	3	2	3.5	0.5	1.1
Average.		3.2	2.3	1.9	4.2	1.0	1.1
Pogogyne zizyphoroides.							
Central Point, Oregon.	CA 171656	6.5	5	2	5	1.5	1.6
Oroville, Calif.	CA 25668	6	4	3	8	2	2.2
Willows, Calif.	CA 25665	4	3	4	7	1	1.8
Suisun, Calif.	CA 25664	4.5	3.5	3.5	5	1.5	2
Byron Springs, Calif.	CA 145271	4.5	3.5	2.5	4	1	1.7
Coyote, Calif.	St 134508	5.5	3.5	2.5	6	1.5	2
Merced, Calif.	CA 171690	2.5	1.5	2.5	5	2	2
White Rock, Calif.	UC 25604	5	4	3	7	1	1.8
Average.		4.8	3.5	2.9	5.9	1.4	1.9

4b. **Pogogyne serpylloides intermedia** J. T. Howell, subsp. nov.

Plants few-branched from the base, the stems rather stiffly erect, rarely spreading; flowers in approximate whorls, the inflorescence oblong-capitate, rarely 1 of the lower whorls distinct.

Sierra Nevada foothills and Coast Ranges of central California.

Type: no. 25672, Herb. Calif. Acad. Sci., collected by Guirado (no. 714), at **San Juan, San Benito Co., Calif.**

Other collections. San Juan, San Benito Co., *Guirado 714* (G, UC); Livermore, Alameda Co., *Jepson in 1891* (UC); Live Oaks, San Joaquin Co., *Rattan in 1880* (St); St. Lawrence, Eldorado Co., *Jones in 1882* (Po); California, *Andrews* (G).

In this subspecies the more apparent characters that separate *P. serpylloides* and *P. zizyphoroides* find a definite transition from one species to the other. In an adequate collection of the two species a series can be arranged passing by every intergrade of habit, foliage, and flower from typical specimens of *P. serpylloides* to specimens of *P. zizyphoroides*. The following series can be arranged from the specimens of these species found in the Herbarium of the California Academy of Sciences: (1.) Oakland Hills, *Goldsmith;* (2.) Monterey County, *Abbott;* (3.) Mokelumne Hill, *Blaisdell;* (4.) San Juan, *Guirado;* (5.) Suisun, *Eastwood;* (6.) Merced, *J. T. Howell;* (7.) Willows, *Eastwood;* (8.) Oroville, *Heller*. This sequence passes by gradual intergrades from plants with habit typical of *P. serpylloides* (1 to 3) to plants typical of the more robust habit of *P. zizyphoroides* (5 to 8). In this series the intermediate form from San Juan (4) with its stricter habit and compact inflorescence, resembles the less robust aspects of *P. zizyphoroides,* but it is definitely referable to *P. serpylloides* on the size-character of the nutlets. Because of the approximation of this form to *P. zizyphoroides* while yet maintaining the one essential characteristic of *P. serpylloides,* it

has seemed proper to treat it as a distinct subspecies. Although plants constituting subsp. *intermedia* are very distinctive in appearance, it has been difficult to separate it from subsp. *typica* because of the nature of variations in the latter, especially in the more diminutive specimens which are very frequently unbranched and bear single capitate flower-clusters. It is interesting that there are apparently no quantitative data by which subsp. *typica* and subsp. *intermedia* can be separated; but this might be expected since only a single quantitative character is available for the adequate separation of the species *P. serpylloides* and *P. zizyphoroides*.

Andrews' specimen of *P. serpylloides intermedia* in the Gray Herbarium is labelled in Gray's hand-writing "*P. zizyphoroides* var. *magis evoluta*."

5. **Pogogyne zizyphoroides** Benth., Pl. Hartw. 330 (1849).

Hedeomoides zizyphoroides (Benth.) Briquet *in* Engler and Prantl, Nat. Pfl. 4, abt. 3a: 295 (1896).

Stems simple or branched, 0.5–2 dm. tall, erect or somewhat spreading; leaf-blade ovate to oblong or broadly elliptic, 0.4–1.5 cm. long, 0.2–1 cm. wide, glabrous or the margins minutely scaberulous, obtuse, entire, narrowed below to a broad petiole 0.2–0.7 cm. long, the petioles of the upper leaves frequently ciliate-margined; floral bracts equalling or exceeding the calyx, spathulate to slender-oblanceolate, conspicuously ciliate on the margins; flowers in dense heads or the lower whorls distinct from the terminal capitate cluster; calyx-tube 2.5–5 mm. long, glabrous or nearly so, rarely the nerves somewhat bristly; lower calyx-lobes 2.5–6 mm. long, the upper lobes 1.5–4 mm. long, the middle upper lobe frequently 0.5–1 mm. shorter than the two lateral upper lobes, the margins and nerves of the lobes bristly-hairy; corolla lavender, 4–8 mm. long; lower pair of stamens fertile, 1–2 mm. long, the upper pair sterile and present as club-shaped rudiments; style 3–7 mm. long, lightly hairy below branches; nutlets obovate, dark brown, 1.6–2.5 mm. long.

Dried beds of vernal pools in clay soil, frequently alkaline in character: Jackson Co., Oregon; plains and low bounding hills of the Sacramento and San Joaquin valleys, Butte Co. south to Mariposa and Merced cos.; occasional in valleys of the Coast Ranges in the San Francisco Bay region.

Pogogyne zizyphoroides Benth. was first collected "in valle Sacramento" by Hartweg.

Collections. Oregon: Central Point, Jackson Co., *Howell 777* (CA, G, O); road to Goldhill, Jackson Co., *Henderson 12383 and 12400* (CA, O). California: California, *Hartweg 1915* (type collection, G); hills 8 miles north of Oroville, Butte Co., *Heller 11275* (CA, G, St, UC); Willows, Glenn Co., *Eastwood 10204* (CA); 4 miles east of Williams, Colusa Co., *Ferris 544* (St); Suisun, Solano Co., *Eastwood 10407* (CA); Byron Springs, Contra Costa Co., *Eastwood 14443* (CA); above Niles, Alameda Co., *Jones in 1882* (Po); Coyote Station, Santa Clara Co., *Congdon in 1881* (St); Merced, Merced Co., *Eastwood 4406* (CA); Merced plains, Merced Co., *J. T. Howell 998* (CA); White Rock, Mariposa Co., *Congdon in 1903* (UC). The present disposition of the Oregon collections of this species is discussed in Madroño 2: 20 (1931).

Comparing the tables of measurements for *P. zizyphoroides* and *P. serpylloides* it is seen that there is an overlap in all data except the length-measurements of the nutlets. In all specimens studied this size-character has been found adequate for the definite quantitative separation of the two species. It will be noted, however, that in all the other sets of data, the sizes of floral structures are larger on the whole and in averages for *P. zizyphoroides* and that it is only in few exceptional cases of both species that the observed overlap occurs. Because of this overlap these data have not been available as diagnostic characters, but the differences shown by the averages strengthen the conclusion that *P. zizyphoroides* and *P. serpylloides* are two distinct specific entities. The apparent interrelation of the two species is treated further in the discussion of *P. serpylloides intermedia*.

6. **Pogogyne tenuiflora** Gray, Proc. Amer. Acad. 11: 100 (1876).

Plate 1.

Hediomoides tenuiflora (Gray) Briquet *in* Engler and Prantl, Nat. Pfl. 4, abt. 3a: 295 (1896).

Stems erect, 1 dm. tall; leaves obovate, obtuse, the margins slightly bristly or glabrous, with pair of salient teeth; floral bracts linear to oblanceolate, finely ciliate, pungent, about equalling the calyx; calyx-lobes finely ciliate, the lower lobes 6 mm. long, the upper lobes 5 mm. long, nerves of calyx puberulent; corolla 12 mm. long, tubular-salverform, pubescent without; lower pair of stamens fertile, 3 mm. long, upper pair sterile, capitellate, 2 mm. long; style hairy 3 mm. below branches, the branches unequal.

Pogogyne tenuiflora Gray is known only from the type collection made in 1875: Guadalupe Island, Lower California, *Palmer 65* (G).